At-Wavelength Optical Metrology Development at the ALS

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Abstract text:

Nano-focusing and brightness preservation for ever brighter synchrotron radiation and free electron laser beamlines require surface slope tolerances of x-ray optics on the order of 100-nrad. While the accuracy of fabrication and *ex situ* metrology of x-ray mirrors has improved over time, beamline performance of the optics is often limited by application specific factors such as x-ray beam heat loading, temperature drift, alignment, vibration, etc. In the present work, we discuss the recent results developing at the Advanced Light Source high-accuracy, *in situ,* at-wavelength wavefront measurement techniques to surpass 100-nrad accuracy surface slope measurements with reflecting x-ray optics. The techniques will ultimately allow closed-loop feedback systems to be implemented for x-ray nano-focusing. In addition, we will present details of a dedicated metrology beamline endstation, applicable to a wide range of *in situ* metrology and test experiments. The design and performance of a bendable Kirkpatrick-Baez (KB) mirror with active temperature stabilization will also be presented. The mirror is currently used to study, refine, and optimize *in situ* mirror bending and metrology methods essential for nano-focusing application.

Keywords: at-wavelength, optical metrology, nano-focusing, slope measurement, x-ray optics, synchrotron radiation, interferometer

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Principle author's biography:

Sheng Yuan received his BS degree in Physics from the University of Science & Technology of China in 2000. He received his MS and PhD degrees from the College of Optical Sciences of University of Arizona in 2006 and 2008, respectively. During his PhD study, he developed primary aberration theory for anamorphic optical systems. He now works as a post-doctoral researcher at the Advanced Light Source, Lawrence Berkeley National Laboratory. His current responsibilities are in the development of at-wavelength optical metrology techniques for x-ray nano-focusing, and the specification of x-ray optical systems.